Analyzing changes in ant communities after habitat management for an endangered songbird (*Vireo atricapilla*)

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Abstract

In 2011, the City of Austin reproduced the Black-capped Vireo (*Vireo atricapilla*) habitat in a portion of the Vireo Preserve. They managed the habitat by removing vegetation by hand or with machinery. This long-term project monitors the effects of this disturbance on the biodiversity of ants. Although ants and the vireo are not directly linked as prey and predator, they will share the habitat. Ants also perform important ecological functions such as seed dispersal, and plant-arthropod interactions. Monitoring ant species and their abundance, can give an indication of how well the habitat can sustain biodiversity and how functional it is. If the habitat cannot sustain ant biodiversity, it may be even more inadequate to sustain the BCV. Two years of data show that there has been an increase of biodiversity at the managed site. Analyses also show that the ant composition in the managed and unmanaged site may also be becoming more similar.

Introduction

Background

The Black-Capped Vireo (BCV; *Vireo atricapilla*) is a small neotropical migratory songbird that has a breeding range from Coahuila, Mexico to Oklahoma. The BCV was declared endangered in 1987 (Wilkins et al. 2006). The decline of the BCV can be attributed to a combination of nest parasitism, habitat destruction caused by overgrazing, and habitat loss due to urbanization (Wilkins et. al 2006). This bird prefers dense underbrush composed of deciduous woody shrubs and trees typical of early successional stages after a wild fire. The low vegetation is typically between 0-2 meters in height, with total woody cover between 35-55% (Grzybowski et al. 1994).

In Austin, Texas, the Vireo Preserve once supported one of the largest breeding populations of BCV in its range (Grybowski 1985). However, the urbanization surrounding the preserve has reduced the likelihood of wild fires (even controlled wild fires) (Wilkins et al. 2006). The absence of fire has allowed trees to mature, especially Ashe juniper (*Juniperus ashei*), making an unsuitable habitat for BCVs. Therefore, the City of Austin, devised a management plan to recreate a suitable habitat for BCVs. To manage the area for BCV habitat enhancement, portions of the Vireo Preserve underwent mechanical clearing and hand clearing in 2011. Target woody species with a height between 8 to 15 feet were removed. Depending on the slope of the land the target species were either hand-cleared (slope >15%) or mechanically removed (slope <15%).

In the years since management efforts were implemented at the Vireo Preserve, researchers have been monitoring ant communities as an indicator of the biodiversity and ecosystem function at the site. Invertebrates are considered useful in monitoring biodiversity

because they can be easily sampled, they are also diverse, abundant, sensitive to disturbance, and ecologically important (Anderson et. Al 2004, Graham et al. 2004). By looking at trends in ant diversity and composition, researchers in Australia have monitored restoration processes (Majer 1983). Ants have different functional roles from primary consumers (e.g. harvester ants) to predators. They also play a role in soil ventilation, seed dispersal, and arthropod-plant interactions. Since ants have perennial nests, they remain in the same area year after year, making long-term monitoring possible.

Purpose

The purpose of this study is to monitor the long-term effects of habitat manipulation for BCV, using ant species biodiversity as an indicator for overall ecosystem effects. Although ants and BCVs are not directly linked as prey and predator (Wilkins et. al 2006). However, ant species community composition and abundance can possibly reflect disturbance in the BCV habitat. If the habitat has not attenuated to disturbance, or the habitat is not stable enough to support ant species, the habitat may be less suited to support the BCV. Therefore, it is important monitor ant communities, to determine whether the habitat is stable and can support a variety of organisms from ants to BCVs.

Methods and Materials

Study Area

The Vireo Preserve, formally called the Black-Capped Vireo Research Area, forms part of the Balcones Canyon Land Preserve (BCP) and is directly north of and adjacent to Wild Basin. This area was established for preservation of the BCV.

Sampling was done at two sites in the Vireo Preserve – a managed and an unmanaged plot (Appendix A). The managed plot underwent mechanical clearing and hand clearing in 2011, as described above. The unmanaged plot has not had treatment. It is a grassy clearing, surrounded by Juniper-Oak Woodland.

Ant Sampling

To gather ant samples at each site, twenty pitfall traps were set up in a four by five grid with 10 meters between each trap. Each pitfall trap consisted of a PVC pipe and an 80cc centrifuge tube with the grooved top portion removed. To create the holes for the pitfall traps a 1-inch by 7-inch conduit was hammered into the ground. The hole was filled by a PVC pipe 7 cm in length. When the traps were not in use the cut centrifuge tubes were replaced with capped tubes to prevent capturing organisms.

If any traps needed to be replaced due to damage, or removal by weather or animals, the traps were left unbaited to prevent the digging in effect (Greenslade 1973). Sampling immediately after making a new pitfall trap would skew the data, because the ant sample would be affected by the soil disturbance.

When the pitfalls were in use, the closed centrifuge tubes would be replaced with tubes that had the grooved portion removed. The tubes were then filled halfway with non-toxic antifreeze. The pitfalls were then picked up five days later (e.g. if set Monday picked up Friday). Each centrifuge tube was removed and placed inside a labeled Whirl-Pak® with a label inside

the bag as well. The samples were then sorted for ants, pinned and identified to species. We used the ecodist package (Goslee & Urban 2007) as implemented in R to calculate the ecological distance between ant communities in the unmanaged and managed sites.

Results

Table 1**:** Ant species observed at the managed and unmanaged sites at the Vireo Preserve (2013-2015).

Ant Species	2013 Managed	2013 Unmanaged	2014 Managed	2014 Unmanaged	2015 Managed	2015 Unmanaged
Aphaenogaster Sp A	3	2	0	0		
Campanotus festinatus	0	5	3	1		
Crematogaster laeviscula	3	12	0	0		
Crematogaster punctulata	0	8	0	11		
Cyphomyrmex rimosus	3	1	1	0		
Forelius mccooki	0	0	1	0		
Forelius privinosis	95	46	61	204		
Forelius Sp B	7	5	0	0		
Labidus coecus latrelle	3	1	0	5		
Monomorium minimum	4	26	16	10		
Myrmecina americana	0	1	0	0		
Neivamyrmex fallax	0	0	0	2		
Paratrechina longicornis	1	1	0	0		
Pheidole (A)	7	12	0	0		
Pheidole (B)	7	25	0	0		
Pheidole ©	4	6	0	0		
Pheidole (D)	8	1	0	0		
Pheidole dentata	435	76	80	69		
Pheidole hyatti	9	1	12	16		
Pheidole metallescens	21	36	0	0		
Pheidole tetra	8	2	5	19		
Solenopsis aurea	0	6	0	4		
Solenopsis invictus	52	1	23	5		
Solenopsis xyloni	0	144	14	25		
Trachymyrmex turrifex	7	1	1	0		
Total ants per site	677	419	218	372		
Number of species per site	18	23	12	13		

In 2013, the total number of species was 23, with 18 of those species shared between the managed and unmanaged sites (Table 1). The most abundant species in both sites were *Pheidole dentata* and *Forelius pruinosus*. In 2014, the total number of species was 18, with 7 of

those species shared between the sites (Table 1). The most abundant species in this year were also *P. dentata* and *F. pruinosus*.

A Sorenson (Bray Curtis; *BC*) ecological distance measure was used to compare the dissimilarity between the two group's compositions across years. Values range between 0, which means same composition and 1 which means no species are shared. In 2013, the ecological distance between the managed and unmanaged sites was *BC*=0.65. In 2014, the ecological distance between sites was *BC*=0.39.

Simpson's Diversity index (*D)* was also conducted to compare diversity between the sites, as well as across years. Values can range from 0, which means no diversity to 1, which is most diverse. In 2013, the diversity index for the managed site was *D*=0.1208. In 2014, the diversity index for the managed site increased to *D*=0.7667. In 2014, the diversity index for the unmanaged site was *D*=0.6426.

Discussion

From 2013 to 2014, there was a decline in the total number of species for both the managed and unmanaged sites. Although the number of species decreased, Simpson's Index indicates that the diversity of the managed site increased (*D*= 0.77). Since Simpson's index takes into account species richness and species abundance, the increase in diversity is most likely due to an increase in species abundance. In other words, although there are less species at the managed site, the species present have high relative abundance to one another.

The ecological distance measure decreased from 2013 to 2014. The managed and unmanaged site ant communities were more dissimilar in 2013 (*BC*=0.65) than in 2014 (*BC*=0.39). This could indicate a trend that the two sites are becoming more similar with time. Since the unmanaged site is an established ecosystem and it has shown a steady diversity, it is possible that the managed site is heading in the same trajectory. However, only more years of data can confirm this possible trend.

Due to rainfall identification of the ant pitfall samples for summer 2015 have not been completed. However, once data collection is completed, ant community patterns across years can be better studied. Further research would include comparing rainfall trends to ant biodiversity of the sites to see if rainfall affects. Monitoring of the invasive species *Solenopsis invicta* (red imported fire ant) is also of interest because invasive species can be known to take resources away from native species.

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Assessment

Although the research I conducted is not directly tied to my medical school goals, the experience of working with others, and communicating my findings are skills I can apply in any field. This research experience has also allowed me to explore other interests. I may not be proficient in identifying ants, but this experience has reminded me that I can develop new skills. It has also taught me that science is inter-disciplinary. I would recommend this experience to all of my peers, no matter what their future plans are because few undergraduates get to have this valuable experience. I do plan to finish sorting through the data for summer 2015.

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